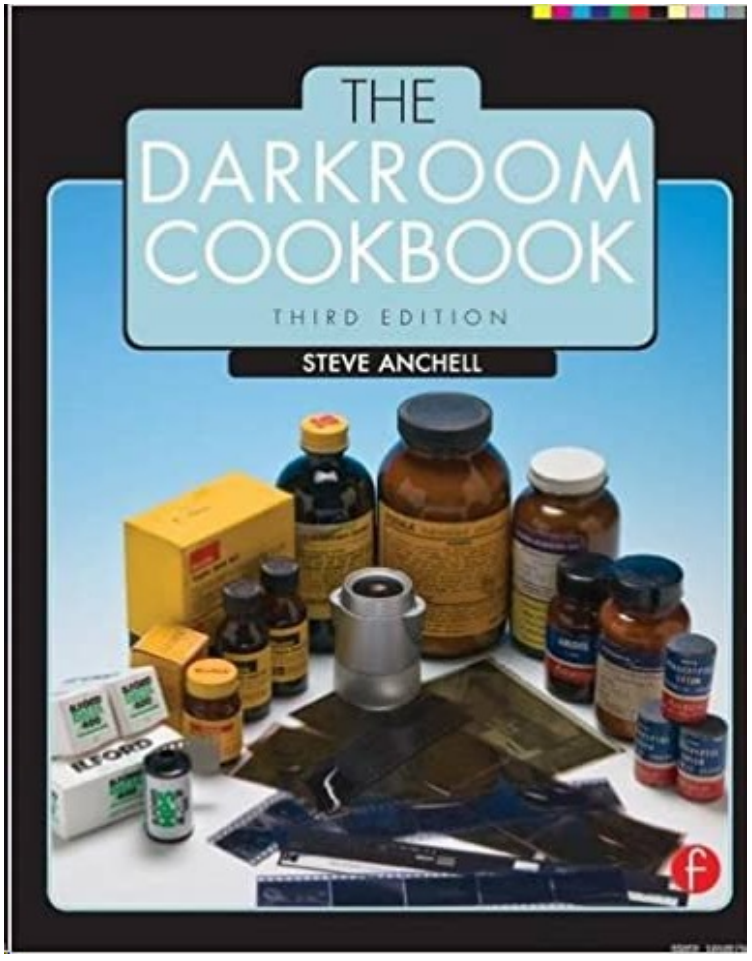
Expanding Your Photographic Chemistry "I.Q."

The knowledge of rudimentary, or basic, chemistry is one of the more important aspects of the making a chemical photographer (*Often miscalled "analog"*). However - Just how much knowhow is important? Certainly, a "college degree" is Not at all a necessity. Ansel Adams, Edward Weston, his sons, and many, many other great photographers, did not have advanced knowledge of chemistry. They did use common sense with safety precautions with their chemistry - And That is What We Must do.

One of the BEST references for "**Chemical Photography**" is the ***"Darkroom Cookbook" by Steven Anchell***, and is - I believe - an absolute MUST in any chemical darkroom. In this article, I will make references and "quotes" from the Third Edition of this book. (Please keep that in mind as the "quoted page numbers" are concerned.) Steve Anchell has done one great job of this written text and the assemblage of the collective work, as well as his straightforward approach to the written delivery.

(If you do not have a copy of this volume - I respectfully suggest that You Get a Copy of This Book.)



So - With this in mind, being that we, here on this “Facebook Page”, are all experimenters, let us all delve into what works for making our Photographic Art through the miracle of chemistry.

- First Things First -

SAFETY -

Most of the substances used in what we do are poisonous to the human and animal body. The use of common sense is a MUST. Do NOT mix your chemicals in the kitchen, or around foods, consumable drinks, and or other “stuff” that may be used in or on the human body. READ EVERYTHING about the substances you are about to use. Keep Notes - and write warnings, and or symbols, for yourself. Ware protective clothing, Safety goggles, Apron, and Neoprene Gloves. NOT just common latex types.

CHEMICAL STORAGE -

Keep ALL your chemicals in a safe area, away from ALL children, pets, and anyone else who is not knowledgeable with the processes. (I keep Most of my chemicals in a 14X14X14 inch box.) If you have children, build a makeshift darkroom in the basement with a door and a LOCK on it. If you do not have a basement, or other room that can be used so the door may be locked - (like I have) = Use a bathroom. However - When you do this, every time you are not using this bathroom for your “darkroom” = you WILL need to clean it up and return it to the original Bathroom.

NEATNESS -

A messy darkroom only means “messy photography”. Keep your darkroom area free of dust, and chemical residues, spills, and mixing vessels CLEAN. (And I mean Clean to the point of *“eating-food-off-the-floor-clean”*.)

Ready to get “adventurous”? Great! Here we go.....

Being that I am mostly interested in the Paper Negative Processes, I have skipped over the working with FILM section of the “*Cookbook*”. Of course, it IS covered very well in the book, but with this article, I am mostly concerned with the making of better paper negatives. And the film development chapters and formulas are good to read, as with all of the photographic processes, to have a “working knowledge” of it all. Most of what I personally do is to concentrate on the “development” of the paper negative, more then the other two main chemicals of the printing process. And with that in mind = “Onward we go”.

In the “Cookbook”, Steve Anchell mentions from the very beginning about the formulas assembled - that “*the formulas are NOT written in stone”*. And the experimenter should feel free to use different percentages and combinations of chemicals that are in the written text. (I might add = within reason = again –> common sense dictates.)

Items that you will need are:

“The Darkroom Cookbook” - (*I even have a copy of this book on my “Kindle” for easy access*)
Chemicals (Photographer’s Formulary = Online)
Small digital scale - or triple bean balance - That can weigh out to the 1/10th gram
Stainless steel small spoon
Filter papers (Regular coffee maker filters will work - but true filter paper is best)
Mixing vessels (Glass or plastic) quart, pint, and smaller (*Save those pickle jars*.)
Mortar and Pastel (for ‘grinding’)
Measuring cups (in Ounces and Milliliters)
Graduated cylinder (metric) - (*Most - if not all measurements - liquid and solid are in metric*)
Funnels - (*Three = Small, Medium, Large - color of Red - “Red your dead - White is alright”*.)
One quart containers (two or three)
One gallon containers (two or three)
Distilled water (one gallon to begin)
Labels (for naming each mixture, on bottles)
Two pencils
Three pens (Black, Blue, Red) - (When in a safelight condition do Not use RED.)
Frosted tape - and “gaffer’s tape” (of course)
One Pack of Litmus Papers (For testing acids and alkalies)
Notebook (For keeping records = Get one)
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That’s about all you will need to conduct your chemical mixes and experiments. Most of the items of this list, you may already have. Or, you may “recycle” or reuse items that you normally would toss away in the trash.

When purchasing the chemicals, you do not have to buy a large quantity of materials. But, I suggest that when you order, make sure that the chemicals are packaged in screw lids and sealed containers. NOT Little Stabled Plastic bags. Some of the chemicals are hygroscopic and will draw moisture - sone will become unusable if this occurs.

For the paper negative experiments - on the next page - I listed what I have in my chemical storage box. However, only you can determine what is best for your experiments.

= Raw Chemicals, Dry - My “Arsenal” =

Instant Coffee Crystals (Real True COFFEE - Not that “decaffeinated” crap.) _ _ |
Sodium Carbonate (washing soda) } For Caffenol
Ascorbic Acid - (Vitamin "C") ___ |
Acetic Acid
Amidol ((Very Toxic) = Be very careful with this stuff.)
Ammonium Chloride
Ammonium Thiosulphate
Ammonium Persulfate
Boric Acid, (crystalline)
Borax
Citric Acid
Copper Sulfate
Ferric Ammonium Citrate
Hydroquinone
Metol
Benzotriazole
Glycin
Phenidone
Silver Nitrate (Poisonous will stain most materials - It Will cause blindness.)
Sodium Acetate
Sodium Bisulfite
Sodium Hydroxide (Very Poisonous material - Use EXTREME Caution - It WILL cause blindness)
Sodium Metaborate
Sodium Metabisulfite
Sodium Sulfide, anhydrous
Sodium Sulfite, anhydrous
Sodium Thiosulphate
Potassium Alum
Potassium Carbonate
Potassium Bichromate
Potassium Bromide
Potassium Ferricyanide
Potassium Iodine
Potassium Metabisulfite
Potassium Oxalate
Pyro
Pyrocatechin
Ionized Salt (common table salt)
16 Oz. Kodak Photo-Flo
10 Oz. Silver Nitrate ((Optional))
16 Oz. - Grain Alcohol 98% ((Optional))
16 Oz. Isopropyl Alcohol 91%
2 Gallons = Distilled Water.
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Remember - You do not have to get all of the above chemicals. This is my personal list - for what I do. You should make your own All the above chemicals are listed in the “Darkroom Cookbook”.

To correctly understand how these chemicals are used, please read over

“Appendix #3 ***“Pharmacopoeia”*** in “The Darkroom Cookbook”.

“”Photography

PHARMACOPOEIA

“The artist lives to express himself and in so doing enriches the world.” - Henry Miller

The chemicals listed here represent those used in the formulas in this book.

Familiarizing yourself with the properties and uses of these chemicals will greatly enhance your darkroom skills. In a few cases the chemical will be found under its common name. Information such as common grades and uses will be given where applicable. In a few instances substitutions will be given.

CHEMICAL TERMS

● An acid is a compound usually having a sour taste and capable of neutralizing alkali (most developers are alkaline). Solutions with a pH less than 7 are considered acid. An example of a common acid would be lemon juice.

● An alkali, the opposite of an acid, is a compound, or salt (e.g., sodium metaborate, sodium carbonate), used as an accelerator in photographic developers. Solutions with a pH greater than 7 are considered alkaline. An example of a common alkali would be laundry soap.

● An anhydrous chemical is one with all water removed; it is free from water, or dry (Appendix 2: Chemicals).

● A deliquescent chemical is able to absorb moisture from the air.

● A denaturant is used to render alcohol unfit for drinking.

● Crystalline means that as many water molecules as possible are attached to the chemical’s molecule.

● Decahydrate means having ten molecules of water.

● Desiccated is an older word meaning the same as anhydrous.

● Dihydrate means having two molecules of water.

● Dodecahydrate means having twelve molecules of water.

● Effervescence means giving off bubbles of gas.

● Efflorescent means the crystals have broken down and become covered with powder.

● Hygroscopic is the property of a liquid or solid that attracts moisture from the air.

● Inflammable means being capable of being set on fire.

● Monohydrate (monohydrous) means having one molecule of water (Appendix 2: Chemicals).

● Octahydrate means having eight molecules of water.

● Pentahydrate means having fi ve molecules of water.

● Viscid indicates having a thick, sticky consistency.

Caution: *Treat every chemical as if it were a poison. Wear gloves and other appropriate safety equipment when handling, either in powder or solution. Do not swallow and, most importantly, keep all chemicals away from your eyes*.

PHOTOGRAPHIC CHEMICALS =

ACETIC ACID (see Acid, Acetic)

ACETONE
Synonyms: Dimethyl ketone, Propanone.
Appearance: Colorless liquid.
Uses: As a solvent of most resinous substances. Used in some developer formulas as a source of alkali by reaction with sulfite; useful as a drier and as an ingredient in toning formulas.
Caution: Highly volatile and infl ammable.

ACETONE SODIUM BISULFITE
Synonyms: Acetone sulfite.
Appearance: White crystals, fatty feel, almost odorless, slight sulfur odor.
Uses: Accelerator in Amidol developers.

ACID, ACETIC

Synonyms: Acid methane-carboxylic, Ethanoic acid, Purified pyroligneous acid, Vinegar.

Appearance: Clear, colorless liquid; strong pungent odor.

Common Grades: Glacial USP, 991/2%; USP, 36%; photo, 28%. To prepare 28% photo-grade from glacial grade, dilute 3 parts acid with 8 parts of water (e.g., 150.0 ml of glacial acetic acid to 400.0 ml of water). Glacial grade solidifi es at about 60F/15C. It is easily melted by standing in warm water.

Uses: Hardening and acid fi xing baths; stop baths; as a clearing bath after ferrous oxalate development of bromide paper. Glacial acetic acid can be used as a solvent of gelatin, celluloid, and pyroxylin.

Notes: To prepare lower-strength acids from glacial acetic acid (USP 991/2%) use the following table:

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Diluting Glacial Acetic Acid

Strength Acetic Acid Required	Parts by Weight Water	Parts by Weight 99 1/2% Acid
28%	71	28
36%	63	36
56%	43	56
80%	19	80

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Substitutions: White vinegar is a weak form of acetic acid, varying in strength from 3% to 15%, generally expressed in “grain” content, 10 grain being equivalent to 1%.

The usual vinegar sold in grocery stores is 45 grain or 41/2% acetic acid.

Distilled vinegar of 40- to 150-grain (4% to 15%) may be purchased from vinegar manufacturers or wholesalers. A working-strength stop bath is usually in the 1% to 2% range; mixing 1 part 40-grain vinegar with 2.5 parts water will make a working-strength solution.

Glacial acetic acid should not be added to sodium sulfite without dilution. It may cause decomposition of the sulfite with resulting formation of sulfur dioxide. A 28% acetic acid is the preferred concentration for photographic uses. It should never be added to hypo unless sulfite is present. Sulfurization of the hypo will result.

Caution: High concentrations of acetic acid can cause bad burns on contact with skin. However, working strength stop bath is usually only 1% to 2%, less than ordinary household vinegar.

DO NOT MIX ACETIC ACID WITH HOUSEHOLD BLEACH. Acetic acid reacts with household bleach to form a highly toxic gas.

ACID, ASCORBIC
Synonyms: L-Ascorbic acid, 3-oxo-L-gulofuranolactone (enol form), Vitamin C.
Appearance: White crystals.
Uses: As a developing agent and as a preservative. As a developing agent it acts more vigorously at higher alkalinities. It is slow to get started but gives images with low fog. At low alkalinities, in combination with metol or Phenidone, ascorbic acid is an active, long-lasting developing agent.

Substitutions: The pure vitamin C powder, available from health food stores, can be used. Or you can use the tablet form and crush it to a powder with a mortar and pestle before adding.

Do not weigh the tablets as insoluble starch binder adds weight. Just add up the vitamin C contents (i.e., a 500.0 mg tablet 0.5 grams of vitamin C, a 1000.0 mg tablet 1.0 gram). To remove the starch binder, fi lter the developer solution through a coffee filter (do not use the filter for coffee afterwards!).

Sodium ascorbate or sodium isoascorbate can also be substituted. Use 1.125 times the weight of vitamin C (11.25 grams of either is equivalent to 10.0 grams of ascorbic acid). Hydroquinone can also be replaced by vitamin C.

(see Hydroquinone; Sodium ascorbate; and Sodium isoascorbate)

ACID, BENZOIC
Synonyms: Flowers of benzoin, Phenylformic acid, Phenylmethanoic acid, Benzenecarboxylic acid.
Appearance: White crystalline needles or scales.
Uses: Preservative in emulsions; toning baths; preparing photographic paper. Restrainer in developers; has delaying action or affect upon the swelling of gelatin.

ACID, BORIC
Synonyms: Boracic acid, Hydrogen borate, Orthoboric acid.
Appearance: Colorless, odorless, transparent crystals, fi ne white globules, or a white amorphous powder.
Uses: As a buffer with borax, to maintain a stable pH, even when the developer is greatly diluted.
Notes: Minimizes sludging tendency and improves the hardening properties of fi xing baths containing potassium alum and acetic acid. Can also be used as a stop bath (use 3% to 5% in water).

Crystalline or granular boric acid should be used (there is no practical difference between the two). Powdered boric acid dissolves only with great difficulty, and its use should be avoided.

Caution: Boric acid is used as roach poison and should not be taken internally.

ACID, CITRIC
Appearance: Colorless, odorless crystals or granules efflorescent in dry air, deliquescent in moist. Very soluble in water; freely soluble in alcohol.
Uses: Preservative; in clearing baths, emulsions, etc. As a sequestering agent and as a stop bath.
Common forms: Citric acid can be purchased in powder form from many drug and health food stores.

ACID, HYDROCHLORIC
Synonyms: Chlorhydric acid, HCL, Marine acid, Muriatic acid, Spirit of salt, Spirit of sea salt.
Appearance: Clear, colorless, or slightly yellow, fuming liquid.
Uses: Clearing pyro stains; vanadium, iron, and copper toning processes.
Substitution: A satisfactory substitute for HCL is a mixture of sodium bisulfate and sodium chloride. Mix twice as much sodium bisulfate to sodium chloride to make the substitute. Use four times as much of the substitute as hydrochloric acid required in a formula.

Notes: Concentrated (35% to 37%) HCL is expensive. Considerably less expensive muriatic acid, available from pool suppliers and hardware stores, can be substituted by multiplying the formula amount by 1.17. For example, if the formula calls for 10.0 ml of HCL, multiply by 1.17 and use 11.7 ml of muriatic acid.

Caution: Poisonous; irritating vapor; corrosive. Always add the hydrochloric acid to the water slowly, stirring constantly. Never add the water to the acid; otherwise, the solution may boil and spatter the acid on the hands or face, causing serious burns. Always use a face mask and eye protection.

ACID, NITRIC
Synonyms: Acid axotic, Aqua fortis, Hydrogen nitrate.
Appearance: Heavy, transparent, colorless or yellow, fuming, corrosive liquid.
Uses: Preservative for pyro solutions.
Caution: Intensely poisonous; causes very painful burns. Extremely corrosive. Use proper ventilation and neoprene gloves when working with the concentrated acid. The fumes from concentrated nitric acid are harmful.

Add the acid slowly to the water; never add the water to the acid.

ACID, OXALIC
Synonyms: Ethanedioic acid.
Appearance: Transparent, colorless and odorless crystals. Freely soluble in water and alcohol; slightly soluble in ether.

Uses: Preservative for pyro solutions; sensitizer of platinotype paper; acts as a restrainer with some developers. Removes ink and some developer stains; used in toning and mordanting formulas.

ACID, SULFAMIC
Appearance: White or colorless, non-hygroscopic crystals.
Uses: As an acidifier in ammonium thiosulphate fixing baths.

ACID, SULFURIC
Synonyms: Battery acid, Chamber acid, Contact acid, Dipping acid, Fortifying acid, Hydrogen sulfate, Oil of Vitriol, Tower acid, Vitriolic acid.
Appearance: A heavy, oily, colorless liquid.
Uses: Preservative for pyro solutions; in acid fixing baths and bleaching solutions; in chrome alum fixing baths.

Caution: Poisonous and very corrosive. Always add the sulfuric acid to the water slowly, stirring constantly, and never add the water to the acid; otherwise, the solution may boil and spatter the acid on the hands or face, causing serious burns. Always wear a face mask and eye protection.

ACID, TARTARIC
Appearance: Colorless transparent crystals or granules.
Uses: Preservative for sensitized paper and emulsions.

AEROSOL OT (DOCUSATE SODIUM)
Appearance: A waxy, solid pellet.
Uses: As a wetting agent for film used before drying.
Notes: Aerosol OT is the dio-ctylester of sodium sulfo-succinic acid.
The standard working solution to make a wetting agent is 0.1%, but the exact strength is not critical.

AGAR
Synonyms: Agar-agar, Japan Agar; Bengal, Ceylon, Chinese or Japan Isinglass or Gelatin; Layor Carang.
Appearance: Long, transparent, odorless, tasteless strips or coarse or fi ne powder.
Uses: Making photographic emulsions.
Notes: Insoluble in cold water; slowly soluble in hot water to a viscid solution. A 1% solution forms a stiff jelly upon cooling.

ALCOHOL, ETHYL
Synonyms: Alcohol, Cologne spirits, Ethanol, Ethyl hydrate, Fermentation alcohol, Grain alcohol, Rectified spirits, Spirits of wine.
Appearance: Transparent, colorless, mobile, and volatile liquid, with a slight characteristic color.

Uses: As a preservative in photographic emulsions; concentrated developers; rapid drying and cleaning.
Notes: 40% alcohol is the equivalent of 40% by volume or 80 proof alcohol.
Caution: Inflammable.

ALCOHOL, ISOPROPYL
Synonyms: Dimethylcarbinol, Isopropanol, Secondary propel alcohol.
Appearance: Colorless liquid; weak alcoholic odor resembling that of acetone.
Uses: In developing formulas for its high solvent properties. To replace alcohol wherever it is called for. To control the diffusion of solutions into emulsions.
Caution: flammable.

ALCOHOL, METHYL
Synonyms: Carbinol, Colonial spirit, Columbian spirits, Methyl hydrate, Methylic alcohol, Methanol, Pyroligneous spirit, Pyroxylic spirit, Wood alcohol, Wood naphtha.
Appearance: Clear, colorless, mobile liquid.

Uses: For denaturing ethyl alcohol; solvent; in preparing very concentrated solutions of developers; cleaning prints and negatives; to control diffusion of solutions into emulsions; the making of film cement.

Caution: Burns with a non-illuminating flame. The presence of excessive amounts of methyl alcohol may cause softening of the film base.

ALCOHOL, TERTIARY BUTYL
Synonyms: Tri-methyl-carbinol, Tertiary isobutyl alcohol, Tertiary butyl alcohol.
Appearance: Colorless crystals, camphor color. Melts at 78F/26C to a colorless, viscid liquid.
Uses: Film cleaner.

ALUM (see Alum, ammonia; Alum, chrome, potassium; Alum, potassium; and Aluminum sulfate)

ALUM, AMMONIA
Synonyms: Alum, Aluminum-ammonia sulfate, Ammonium alum.
Appearance: Colorless crystals or white powder; styptic taste.
Uses: In fi xing baths; hypo-alum (sulfi de) toning; hardener for gelatin.

ALUM, CHROME, POTASSIUM
Synonyms: Chrome alum, Chromium and potassium sulfate, Potassium chromium sulfate.
Appearance: Dark violet-red crystals (ruby red by transmitted light); or light violet powder.
Uses: Preparation of chrome alum fixing bath; as hardening agent for gelatin.

ALUM, IRON
Synonyms: Ammonio-ferric alum, Ammonia-ferric sulfate, Ammonium sulfate, Ferric ammonium alum, Ferric ammonium sulfate, Ferric alum, Iron ammonia sulfate, Iron ammonium alum, Iron sulfate.
Appearance: Violet efflorescent crystals.
Uses: In reducer formulas; toning solutions; sensitizing solutions.

ALUM, POTASSIUM
Synonyms: Alum, Alum fl our, Alum meal, Aluminite, Aluminum and potassium sulfate, Common alum, Cube alum, Double sulfate of aluminum and potassium, Octohedral alum salt, Potash alum, Potassic-aluminic sulfate, Potassium-aluminum sulfate, Roman alum, Sulfate of aluminum and potassium.
Appearance: Large, colorless, hard, transparent crystals or white crystalline powder.
Uses: Hardening solutions for fixing baths; ingredient of the hypo-alum toning bath; clearing bath.
Substitutions: Cake alum, found in grocery stores, can be substituted for potassium alum.

ALUMINUM CHLORIDE HEXAHYDRATE
(Not to be confused with Anhydrous Aluminum Chloride)
Appearance: White or yellowish white, deliquescent, crystalline powder. It is nearly odorless and has a sweetish, very astringent taste.
Uses: In photography as a hardener in acid fi xing baths that use ammonium thiosulfate as a solvent for silver halides.

Notes: 1.0 gram is soluble in 0.5 ml of water at 77F/25C.

Caution: Incompatible with alkali.

ALUMINUM SULFATE
Synonyms: Concentrated alum, Paper-maker's alum, Sulfate of alumina.
Appearance: White, lustrous crystals, granules, or powder.
Uses: Can be used as a substitute for alum as a hardener (ratio 2 parts aluminum sulfate as a substitute for 3 parts alum).

(see Alum, ammonium; Alum, chrome; and Alum, potassium)

AMIDOL
Formulas: Diaminophenol, 2,4 Diaminophenol dihydrochloride.
Trade Names: Acrol, Dianol.
Appearance: Fine white or bluish gray crystals.
Uses: A rapidly working developer requiring only sulfite as an accelerator. Primarily used for printing, but occasionally for negatives. Oxidizes rapidly and keeps poorly.

Notes: Amidol is one of the finest developing agents for blue-black tones on soft-emulsion bromide paper. It is also capable of creating neutral-blacks with a fi ne scale and transparency in the shadows.

Amidol is very soluble in water or sulfite. The keeping properties of amidol in solution can be improved by the addition of a weak acid, such as lactic or citric acid. Amidol is energized by sodium sulfite alone, without the necessity of adding any alkali.

Caution: Amidol is considered to be toxic. Avoid contact with eyes, skin, and clothing. In case of contact, flush eyes and skin with water. The dry powder should not be inhaled when mixing. Mixing should be performed in a well-ventilated area using gloves, goggles, dust mask, and an apron. Use gloves when using the formula. Amidol is highly staining to both skin and clothing.

AMMONIUM ALUM (see Alum, Ammonium)

AMMONIUM BROMIDE
Appearance: White crystalline powder.
Uses: As a restrainer.
Caution: Should not be used with caustic alkali or carbonates as ammonium is liberated.

AMMONIUM CARBONATE
Synonyms: Ammonium carbaminate, Harthorn, Rock ammonia (a mixture of ammonium carbonate and ammonium bicarbonate).
Appearance: White, hard, translucent lumps or cubes.
Uses: Replaces potassium and sodium carbonate as an accelerator; replaces ammonia water in some solutions.

Notes: Converts to bicarbonate upon exposure to air.

AMMONIUM CHLORIDE
Synonyms: Ammonium hydrochloride, Chloride of ammonia, Hydrochloride of ammonia, Muriate of ammonia, Sal ammoniac.
Appearance: White, odorless granules or powder.
Uses: To make rapid fi xing baths, as an accelerator in sodium thiosulfate-based fixing baths; also used in chloride and salted albumen papers. Mild silver halide solvent.

AMMONIUM HYDROXIDE
Synonyms: Ammonia water, Strong solution of ammonia.
Appearance: Colorless liquid; intense, pungent, suffocating odor.
Uses: Accelerator of developing solutions; caustic, tending to enlarge grain structure of negatives; hypersensitizing films. An emulsion softener; causes fog on fast films.

Caution: Keep cool in strong, glass-stoppered bottles not completely filled.

AMMONIUM PERSULFATE
Synonyms: Persulfate of ammonia.
Appearance: Colorless crystals or white crystalline powder.
Uses: Flattening reducer (i.e., reduces highlight detail more than shadows); removes developer stains.

AMMONIUM THIOCYANATE
Synonyms: Ammonium rhodanthe, Ammonium rhodanide, Ammonium sulfocyanide, Ammonium sulfocyanate, Ammonium thiocyanide.
Appearance: Colorless, deliquescent crystals.
Uses: For gold toning printing-out paper.
Caution: Keep well stoppered.

AMMONIUM THIOSULFATE
Synonyms: Ammonium hyposulfite.
Appearance: Colorless anhydrous crystals; sold in 60% solution.
Uses: Sometimes substituted for the sodium salt in rapid fixing baths. A 15% to 20% solution of ammonium thiosulfate is capable of more rapid fixation than a 35% to 40% solution of sodium thiosulphate.

ANTI-FOG NO. 1 (see Benzotriazole)

ANTI-FOG NO. 2 (6-NITROBENZIMIDAZOLE NITRATE)
Appearance: Colorless crystals or white powder.
Uses: Anti-foggant and density depressant in developers.

BAKING SODA (see Sodium bicarbonate)

BALANCED ALKALI (KODALK)
Appearance: White crystals.
Uses: An alkali used as an accelerator in developers of intermediate activity between that of carbonate and borax. Developers containing Balanced Alkali usually have a pH range of 9.0 to 10.0, and the concentration varies from 2 to 50 g/L.

An advantage of this alkali is the almost proportionate change in developer activity with varying alkali concentration, permitting precise adjustments of the activity of a moderately alkaline developer.

A second advantage is that Balanced Alkali does not release a gas when added to an acid rinse or an acid fi xing bath; hence it minimizes “blistering.”

Substitutions: Balanced Alkali is a proprietary formula of the Eastman Kodak Company and is no longer being produced. However, there are many published formulas which still call for it. The composition is known to be sodium metaborate, octahydrate. Sodium metaborate is commonly sold in the octahydrate state, as it is the most stable. Therefore, weight-for-weight substitution can be made.

Sodium carbonate can also be used as a substitute for Balanced Alkali. Two parts by weight of Balanced Alkali is approximately equivalent to 1 part by weight of sodium carbonate,

monohydrate, in normal developers. A more precise substitution is to use 5.9 grams of sodium carbonate, monohydrate, for each 10.0 grams of Balanced Alkali.

Yet another substitution is to use 4 parts sodium carbonate, monohydrate, and 1 part borax to equal the same weight of Balanced Alkali (e.g., 10.0 grams of Balanced Alkali equals 8.0 grams of carbonate and 2.0 grams of borax).

Notes: A sludge of basic aluminum sulfite is occasionally formed when a developer containing sodium carbonate reacts with a partially exhausted acid-hardening fixing bath. This slugging tendency of certain fixing baths is minimized when developers containing Balanced Alkali are used. (see Sodium Metaborate)

BENZOIC ACID (see Acid, Benzoic)

BENZOTRIAZOLE
Synonyms: Aziminobenzene, Benzisotriazole.
Trade Names: Edwal’s Liquid Orthazite, which contains approximately a 3% solution of benzotriazole with sodium sulfite. Kodak Anti-Fog #1 (no longer manufactured).
Appearance: Colorless crystals or white powder.
Uses: Organic anti-foggant and density depressant in developers. Benzotriazole acts as a restrainer without affecting other properties of the developer. It can also be used as a fog restrainer when processing outdated paper.

Notes: When blue-black or cold-black image tones are desired with bromide papers, benzotriazole should be used in addition to, or substituted for, potassium bromide. Make a 0.2% solution of benzotriazole (2.0 grams benzotriazole in water at 125F/52C to make 1.0 liter) then reduce the bromide to 1/10 or 1/6 strength and use just enough benzotriazole solution to prevent developer stain or fog. A little experimentation will be required.

The same treatment can be applied to chloride and chlorobromide papers to eliminate any greenish black tendencies and/or achieve a blue-black tone.

Benzotriazole does not dissolve readily in cold water. Use hot water - 125F/52C or higher.

BORAX

Synonyms: Bicornate of soda, Bicornate of sodium, Borate of soda, Borate of sodium, Purified borax, Pyroborate of soda, Sodium bilobate, Sodium borate, Sodium pyroborate, Sodium tetra borate, Tetraborate of soda.
Trade Names: 20 Mule Team Borax.
Appearance: Pure white crystalline powder.
Uses: As a mild alkali accelerator in fi ne-grain developers and those of low activity; in certain hardening fixing baths and in some acid hardeners, especially those intended for prints that are to be dried though heated belt driers; and in gold toning baths to render them alkaline and to increase the rate of deposition of gold.

Notes: Borax is available as borax, pentahydrate, but most commonly as borax, decahydrate, the form used in photographic formulas. The old term for decahydrate is crystalline. Borax, decahydrate, and 20 Mule Team Borax are one and the same.

BORIC ACID (see Acid, Boric)

BROMCRESOL PURPLE

Synonyms: Dibromo-ortho-cresol sulfonphthalein.
Appearance: Light pink, crystalline powder.
Uses: As an indicator to test the acidity of rinse and stop baths. At pH 5.2 it is yellow, and at pH 6.8 it is purple.

Notes: Practically insoluble in water, but soluble in alcohol and dilute alkali. Mix it in a little alcohol or a small volume of dilute sodium hydroxide, then add to the water.

BROMIDE (see Potassium bromide)

CALCIUM CARBONATE, PRECIPITATED
Synonyms: Aeromatt, Albacar, Purecal, Precipitated chalk.
Appearance: White, odorless, tasteless powder.
Uses: In gold toning.
Notes: Insoluble in water, slightly soluble in water saturated with CO2, with increased solubility in water containing ammonium salts. Dissolves in dilute acids with effervescence.

CALGON
Synonyms: Graham's salt, Sodium hexametaphosphate, Sodium polymetaphosphate.
Appearance: White flaky crystals or granules; small, broken, glass-like particles.
Uses: Water softener. Calgon has the property of holding calcium and magnesium salts in solution, even when boiling.

Notes: This chemical is packaged as Calgon Water Softener.

CARBONATE (see Sodium carbonate)

CATECHOL (see Pyrocatechin)

CAUSTIC ALKALI (see Sodium hydroxide)

CHLORAMINE
Synonyms: Chloramine-T, Chlorazene, Chlorazene, Sodium para Toluenesulfonchloramide, Tochloride.
Appearance: White or faintly yellow crystalline powder with a slight chlorine odor.
Uses: As an efficient hypo eliminator for negatives and prints. Used in very dilute solution (0.2%).

Notes: Slowly decomposes on exposure to air. Should be kept dry and tightly closed. Fairly soluble in water, decomposed by alcohol.

CHLORHYDROQUINONE
Formulas: 2 Chloro-1,4 dihydroxybenzene; 2-Chloro-1,4-benzenediol.
Trade Names: Adurol, Chlorquinol, C.H.Q. (Edwal).
Appearance: Fine white needles or leaflets.
Uses: For warm tones on papers, when restrained with bromide.

Notes: A derivative of hydroquinone, chlorhydroquinone was once a mainstay for warm tone prints. Unfortunately, it is becoming increasingly hard to find, not because it is not useful as a warm-tone developing agent, but because it is both expensive and dangerous to manufacture.

Substitutions: Its developing properties roughly correspond to those of a mixture of hydroquinone with 5% of metol.
(see Hydroquinone)

CHLORINATED LIME
Synonyms: Bleaching powder, “Calcium Hypochlorite.”
Appearance: White or grayish white powder with strong odor of chlorine.
Uses: As a hypo eliminator; in reducing and clearing negatives; stain remover.
Notes: Composition somewhat variable. Usually contains about 35% active chlorine. Becomes moist and rapidly decomposes on exposure to air. Must be kept dry in a tightly closed container.

Caution: Wear gloves and a mask when working with the powder, and use ventilation.

CHROME ALUM (see Alum, Chrome)

CITRIC ACID (see Acid, Citric)

DIAMINOPHENOL HYDROCHLORIDE (see Amidol)

ELON (see Metol)

ETHYL ALCOHOL (see Alcohol, Ethyl)

FERRIC AMMONIUM CITRATE
Synonyms: Ammoniocitrate of iron, Ammonium citrate, Iron citrate, Soluble ferric citrate.
Appearance: Clear green crystals. Occurs also as brown scales, but green scales are preferred for photographic purposes.
Uses: In iron-toning solutions. Fresh ferric ammonium citrate tends to form a layer of mold after a few days. This can be fi ltered or lifted off. After the first time the mold rarely returns.

Notes: Both brown and green salts are light-sensitive. Keep well closed and protected from light.

FERRIC CHLORIDE
Synonyms: Chloride of iron, Ferric trichloride, Flores martis, Iron chloride, Iron per chloride, Iron sesquichloride, Iron trichloride, Sesquichloride of iron.
Appearance: Orange-yellow opaque masses or lumps.
Uses: Reduction; blue-toning.
Notes: Keep in a tightly sealed bottle.

FERRIC OXALATE
Synonyms: Iron Oxalate, Iron sesquioxalate.
Appearance: Greenish crystalline scales or pearls.
Uses: In iron-toning solutions.
Notes: Light-sensitive.

FERRICYANIDE (see Potassium Ferricyanide)

FORMALDEHYDE (see Formalin)

FORMALIN
Synonyms: Formaldehyde Solution, Formol, Morbicid, Veracur.
Appearance: Clear, colorless liquid; suffocating odor.
Uses: Hardening bath (10% solution). In connection with hydroquinone developer, yields negatives of great contrast; useful for developing litho film. A small amount prevents swelling of gelatin in warm solutions. Also useful as a preservative.

Notes: Formalin is an aqueous solution of formaldehyde, 37% by weight or 40% by volume.

Caution: Poisonous; vapors attack mucous membrane of the eyes, nose, throat, causing intense irritation. Use in a well-ventilated area and exercise all handling precautions. Unless your mixing area has an effective fume hood, it is highly recommended that you mix formaldehyde outdoors, and even then an appropriately rated fume mask should be used. These masks are available from chemical supply houses.

GELATIN
Synonyms: Glutin.
Appearance: Colorless or light yellow, transparent, brittle, practically odorless sheets, fl akes, or coarse powder.
Uses: Preparation of emulsions, sizing paper, adhesives, light fi lters.
Notes: Swells up and absorbs fi ve to ten times its weight of cold water.

GLYCERIN
Synonyms: Glycerine, Glycerol, Glyceryl hydroxide, Glycel alcohol.
Appearance: Clear, colorless, syrupy liquid.
Uses: Prevents too rapid drying; keeps gelatin emulsions of paper and films flexible.

GLYCIN
Formulas: para-Hydroxyphenyl glycine; para-Hydroxyphenylamino acetic acid.
Trade Names: Athenon (Kodak), Glyconol, Iconyl, Kodurol, Monazol (Edwal).
Appearance: Glistening white or gray powder.
Uses: Nonstaining, clear-working developer; gives fi ne-grained negatives of a gray-black color.

Commonly used with para-phenylenediamine in fi ne-grain formulas; also used in paper developing formulas.

Notes: Glycin is almost insoluble in water, but it dissolves readily in alkaline solutions, thus it should be added last to any developer formula. It oxidizes very slowly and is very clean working.

Until the advent of 35 mm film, with the resulting emphasis on fine-grain developers, glycin was used mainly in paper developers. Now it is sometimes used in combination with other developing agents for fi ne-grain film development.

Glycin is very sensitive to bromide and also to low temperature. With alkali carbonates it makes slow-working developers, which have good keeping properties and give low contrast. Not to be confused with glyco-coll medicinal, sometimes called glycine.

GOLD CHLORIDE
Synonyms: Aurochlorohydric acid, Chlorauric acid, Gold trichloride (acid).
Appearance: Bright golden yellow crystalline compound.
Uses: Gold toning.
Notes: Contains approximately 50% of gold. Keep in a tightly closed bottle and protected from light.

Caution: Gold chloride can blister the skin and then on exposure to light will leave violet brown spots. Wear gloves when working with the powder or solution.

HYDROCHLORIC ACID (see Acid, Hydrochloric)

HYDRONYX
Appearance: Clear liquid.
Uses: As a wetting agent for film used before drying.

HYDROQUINONE
Formulas: 1,4 Dihydroxybenzene; para-Dihydroxybenzene.
Trade Names: Hydrochinon, Hydroquinol, Quinol, Tecquinol, Hydroquinol.
Appearance: Lustrous, silky, white needles.
Uses: Developer; builds density in combination with other developers.
Substitutions: Vitamin C can be used as a substitute for hydroquinone. Start by using 1.6 times the weight of hydroquinone, and increase the alkali (i.e., borax, carbonate, etc.) by 1.6 times to compensate for the acidity of the vitamin C.

Notes: Hydroquinone is generally a clean-working and nonstaining developer. It oxidizes easily both in solution and as crystals.

At temperatures below 50F/10C hydroquinone developers are inactive. It is extremely susceptible to the action of bromide. When compounded with alkali carbonates it gives a slow working but high contrast developer. With caustic alkali (e.g., sodium hydroxide) its action is very rapid, with the highest possible contrast. For this reason, it is the most widely used developer for technical applications, especially in process work where the highest attainable contrast is essential. In the presence of caustic alkali (i.e., high pH) it is not temperature-sensitive and can be used for low-temperature developing. Hydroquinone developers keep well and are slowly exhausted.

Hydroquinone alone is not largely used, but in combination with metol (MQ) or Phenidone (PQ), it is among the most popular developers. By varying the relative quantities of metol and hydroquinone and adjusting the quantities of sulfite and carbonate, almost any desired contrast or rate of development can be obtained.

HYPO (see Sodium Thiosulfate)

IODINE
Appearance: Violet gray scales.
Uses: For bleaching bromide prints in sulfi de toning; with potassium cyanide as a print reducer; for removing silver stains. Iodine stains on fingers disappear in hypo or sulfite.

IRON ALUM (see Alum, Iron)

ISOPROPYL ALCOHOL (see Alcohol, Isopropyl)

KODALK (see Balanced Alkali)

LIQUID ORTHAZITE (see Benzotriazole)

METHYL ALCOHOL (see Alcohol, Methyl)

METOL
Formulas: Monomethyl para-aminophenol sulfate; para-Methylaminophenyl sulfate.
Trade Names: Claritol (Defender; half-strength metol), Elon (Kodak), Enol, Genol, Graphol, Metol (Agfa and others), Pictol (Mallinckrodt), Photol (Merck), Planetol, Rhodol (DuPont), Veritol (Defender).
Appearance: White to slightly yellowish powder.
Uses: As a developing agent, usually with hydroquinone, but sometimes by itself, as in Kodak D-23.
Substitution: Phenidone can be substituted for metol. Start by using approximately 10% of the quantity of metol.

Notes: Although metol is easily soluble in water, it is not soluble in a strong sodium sulfite solution. It will dissolve readily in a weak solution of sulfite. Metol builds image detail rapidly, and it keeps well in solution.

Metol has low-fogging tendencies and responds well to the addition of bromide, giving a very clean-working developer without any staining of either film or fingers. The energy of the developer is only slightly affected by low temperature and is only slightly reduced by the addition of bromide.

Metol alone with either sodium or potassium carbonate gives a rapid-working developer when the alkali is in high concentration, but the speed of development can easily be controlled by dilution.

The use of caustic alkali (e.g., sodium hydroxide) is not recommended with metol as there is a tendency to excessive fog. When used with sulfite alone, without additional alkali (Kodak D-23), metol provides a slow-working, fi ne-grain developer. This type of film developer often works well with a mild alkali, such as borax, which accelerates the rate of development without increasing the grain size appreciably (Kodak D-25). Developers containing metol as the sole developing agent are not widely used, but metol with hydroquinone provides the most widely used developer combination.

Caution: Metol has a reputation for causing skin poisoning (a painful rash that looks and feels like poison oak). It includes severe itching, red rash, and peeling skin. This poisoning usually occurs after being exposed to the substance over a period of years but in some cases can happen even sooner.

It is believed that metol poisoning results from trace contamination of para-phenylenediamine (ppd) in the metol, not from the metol itself. Knowledge of this has changed the manufacturing process, and as a result, metol poisoning is less common than it once was.

Good-quality metol does not usually cause a rash. However, some people are still sensitive to even the purest grade of metol. It is possible to avoid metol poisoning either by wearing protective gloves or by substituting Phenidone.

MONOMETHYL PARA-AMINOPHENOL SULFATE (see Metol)

NITROBENZIMIDAZOLE NITRATE (see Antifog No. 2)

ORTHO-PHENYLENEDIAMINE (opd)
Formulas: 1,2-Benzenediamine, ortho-Diaminobenzene, para-aminophenol hydrochloride.
Appearance: White to brownish-yellow crystals.
Uses: As a fi ne-grain silver solvent; a substitute for p-phenylenediamine; or very weak developing agent. Usually used in combination with metol. (see para-Phenylenediamine).

PARA - AMINO PHENOL HYDROCHLORIDE
Formulas: 4-Amino-1hydroxy-benzene hydrochloride; para-Hydroxyaniline.
Trade Names: Activol, Azol, Kodelon (Kodak), Para, Rhodinal.
Appearance: White, crystalline substance.
Uses: As a developing agent used in conjunction with sodium or potassium carbonates or with caustic alkali. The sodium salt of this is the developing agent in the concentrated solution of prepared developer. It is marketed under the trade name of Rodinal by Agfa.
Notes: At one time this was a very popular developing agent. In 1931 the Eighth International Congress of Photography adopted as a standard developer for scientific sensitometric work the following formula:

Para - Amino Phenol hydrochloride,	7.25 g
Sodium sulfite, anhydrous,	50.0 g
Sodium carbonate, anhydrous,	50.0 g
Water to make	1.0 liter

p-Aminophenol hydrochloride is very soluble in cold water. Its principal use is in the preparation of very concentrated developers with caustic alkali that could be diluted from 20 to 100 times. Concentrates keep well and should not be diluted until immediately before use.

These developers work rapidly, are free from fogging properties, and do not stain. They are not sensitive to temperature variations, nor do high temperatures affect their clean working. Tropical Process Developer, Kodak D-13, is an example. (D-13 is not given in The Darkroom Cookbook; instead DK-15 and DK-15a are given.)

Carbonate should not be used with this substance as it precipitates out the base and prevents the preparation of any but very dilute solutions.

PARA-AMINOPHENOL SULFATE (see Metol)

PARAFORMALDEHYDE
Synonyms: Paraform, Polymerized formic aldehyde.
Appearance: White, crystalline powder.
Uses: Produces formalin when dissolved in water. It is also an emulsion hardener and reacts with sodium sulfite to form sodium hydroxide. (see Formalin and Cautions under Formalin)

PARA-HYDROXYPHENYL GLYCIN (see Glycin)

PARA-PHENYLENEDIAMINE (ppd)
Formulas: para-Diaminobenzene; 1,4-Diaminobenzene.
Trade Names: Diamine, Diamine P, Paramine Metacarbol (free base), and Para D.
Appearance: White to slightly reddish crystals in photograde s.
Uses: Very low energy developer; produces negatives of minimum graininess. Often used in combination with glycin and/or metol.

Notes: p-Phenylenediamine is the classic superfi ne-grain developer. Besides the cautions that follow, it requires strong overexposure of the film and a very long developing time, often twenty minutes or more, and even then the contrast of the resulting negatives is rather low.

As a result, there have been efforts to replace p-phenylenediamine with other agents. One of the more successful is the Windisch Superfine-Grain Developer that uses o-phenylenediamine.

This agent also has weak developing properties, but it works as a good solvent for silver halide. p-Phenylenediamine is only slightly soluble in water.

Caution: Toxic and stains hands, clothing, and other things on prolonged contact. The free base of p-phenylenediamine and its water soluble salts may cause eczema or other skin irritations.

Always wear a good dust mask when working with the powder and gloves when working with the powder or the solutions. (see ortho-Phenylenediamine and para-Phenylenediamine Hydrochloride)

PARA-PHENYLENEDIAMINE HYDROCHLORIDE
Trade Names: Diamine H, P.D.H.
Appearance: White or grayish white to slightly reddish crystalline powder.
Uses: As a developing agent for fi ne-grain images; used in combination with other developing agents. Para-Phenylenediamine hydrochloride has the same general characteristics as its base (p-phenylenediamine), except that an alkali is required to make it function as a developer. It is preferable to the base on account of better solubility and keeping properties. Unfortunately, much larger quantities are required and therefore all standard formulas use the base.

Notes: Only slightly soluble in water, but much more soluble as the hydrochloride.

Caution: Toxic and stains hands, clothing, and other things on prolonged contact. Can cause eczema and other skin irritations. Always wear a good dust mask when working with the powder and gloves when working with the powder or solutions.

PHENIDONE
Formulas: 1-Phenyl-3-pyrazolidone; 1-Phenyl-3-pyrazilidinone.
Trade Names: Fotodone (Mallinckrodt), Graphidone.
Appearance: White or slightly yellow powder; colorless crystals.
Uses: As a hypo-allergenic developing agent (this means it is unlikely to cause dermatitis) that can be substituted for metol. Sufferers of metol poisoning can often use Phenidone-based developers without ill effects.

Notes: Phenidone is sparingly soluble in cold water and moderately in hot and can require temperatures of 175F/80C to dissolve. It is readily soluble in both aqueous acids and alkali, including solutions of alkali bisulfites and carbonates, so that it can easily be incorporated into a developer solution.

Used alone in sodium carbonate/sulfite solutions, it is very fast but extremely soft working and is only capable of producing negatives of low contrast. In combination with hydroquinone it produces developers with superadditivity that are even more effi cient than MQ developers.

Phenidone-based developers keep better than those based on metol. The reason is the oxidation product of Phenidone is more effi ciently regenerated by hydroquinone than is metol.

Additionally, while the first oxidation product of hydroquinone, mono-sulfonate, forms an almost inert system with metol, it has a superadditive effect with Phenidone, increasing developing power.

Because very small amounts of Phenidone are required, it is often desirable to use a percentage solution. A concentrate of Phenidone, containing a preservative, can be made as follows:

Water at 125F/52C,	750.0 ml
Sodium bisulfite,	6.0 g
Phenidone,	2.0 g
Cold water to make	1.0 liter

100.0 ml of the concentrate contains 0.2 grams of Phenidone. The preservative will have no appreciable effect on any developing formula. Alternately, a 5% concentration can be made using methyl hydrate instead of water, but it does not keep.

Substitution: Phenidone can be substituted for metol. There is evidence that as a substitute for metol it causes a true increase in film speed. Try substituting approximately 10% of the amount of Phenidone for the amount of metol required.

Phenidone should not be used as a substitute in developers in which metol is the sole developing agent, such as Kodak D-23 and D-25.

POTASSA SULPHURETED
Synonyms: Hepar sulfuris, Liver of sulfur, Potassium tri-sulfide.
Appearance: Yellowish brown lumps; slight odor.
Uses: To precipitate silver from photographic waste. Used in toning formulas.

Notes: Decomposes upon exposure to air. Potassa sulphureted often becomes coated with a hard crust having no value. This crust should be broken away as much as possible before weighing out the inner part.

POTASSIUM ALUM (see Alum, Potassium)

POTASSIUM BICHROMATE (see Potassium Dichromate)

POTASSIUM BROMIDE
Synonyms: Bromide, Bromide of potash, Bromide of potassium.
Appearance: White crystalline granules or powder.
Uses: Fog prevention and restrainer in developing solutions.

Notes: Potassium bromide is the most commonly used restrainer in developing formulas, especially those using hydroquinone, pyrocatechin, or pyrogallol. The addition of potassium bromide usually results in a reduction of contrast and can have a warming effect on image tone when used in paper developers. It is also used as an ingredient in intensifying, reducing, toning, and many other photographic solutions.

POTASSIUM CARBONATE
Synonyms: Carbonate of potash, Pearl Ash, Potash, Salt of tartar, Salt of wormwood, Subcarbonate of potash.
Appearance: White, deliquescent, granular powder.
Uses: Since potassium carbonate is more soluble than sodium carbonate it is used in concentrated solutions where an alkali is needed.

Notes: Potassium carbonate can be substituted for sodium carbonate as an alkali accelerator in developers. As its solubility is much greater, developers with greater concentration can be formulated. Thirteen parts by weight are equal to 10 parts by weight of sodium carbonate.

Substituting potassium carbonate for sodium carbonate will help to obtain warmer tones in paper development.
Substitution: To substitute potassium carbonate anhydrous, multiply the amount of sodium carbonate monohydrate by 0.90. (see Sodium carbonate)

POTASSIUM CHLORIDE
Synonyms: Chloride of potash, Muriate of potash.
Appearance: Colorless or white crystals or powder.
Uses: In special developing formulas.

POTASSIUM CITRATE
Synonyms: Tribasic citrate of potash.
Appearance: White granular powder.
Uses: As a restrainer in alkaline development; used in several copper toning baths.

POTASSIUM DICHROMATE
Synonyms: Bichromate of potash, Bichromate of potassa, Potassium dichromate, Red chromate of potash, Red chromate of potassa.
Appearance: Bright, orange-red crystals.
Uses: Bleaching ingredient in tray cleaners and chromium intensifiers.
Notes: Bichromate is the older word for dichromate.

Caution: Potassium dichromate is corrosive and can cause burns. Avoid contact with eyes, skin, and clothing. In case of contact, flush eyes and skin with water. Potassium dichromate can also cause allergic skin reactions; the dust can cause irritation. Mixing should be performed in a well-ventilated area using gloves, goggles, and aprons. Potassium dichromate is asuspected carcinogen.

POTASSIUM FERRICYANIDE
Synonyms: Ferricyanide, Ferricyanide of potash, Red praised of potash.
Appearance: Ruby red, lustrous crystals.
Uses: Principal use is in bleaching baths; iron printing processes; and as a bleach before sulfide toning. Also used in dye-toning formulas.

Notes: Keep protected from light.

POTASSIUM FERROCYANIDE
Synonyms: Ferrocyanide of potash, Yellow prussiate of potash.
Appearance: Lemon yellow crystals or powder.
Uses: A small amount in pyro and hydroquinone developers tends to lower fog and give greater density.

Notes: Light-sensitive in solution.

POTASSIUM HYDROXIDE
Synonyms: Caustic potash, Caustic potassa, Hydrate of potassa, Potassium hydrate.
Appearance: White, deliquescent lumps or sticks.
Uses: Caustic alkali accelerator in development.
Caution: Poisonous; attacks the skin, infl icting severe burns. Extremely corrosive. Keep in a tightly sealed bottle and wear gloves. It is good practice to dissolve potassium hydroxide separately in a small amount of cold water, then add the solution after the developing agent has been dissolved, stirring vigorously.

POTASSIUM IODIDE
Synonyms: Iodide of potash.
Appearance: White crystals, granules, or powder.
Uses: Has the property of reducing emulsion fog. Can be used as a restrainer although this application has not been adequately explored.

POTASSIUM METABISULFITE
Synonyms: Metabisulfite of potash, Potassium pyrosulfite.
Appearance: Transparent needle crystals or crystalline powder.
Uses: As a preservative in developers; used in place of sodium sulfite in some developers. Also used for acidifying fixing baths.

Notes: Replaces sodium bisulfite weight for weight. Deteriorates rapidly in air.

POTASSIUM PERMANGANATE
Synonyms: Permanganate of potash.
Appearance: Purple-black crystals of metallic luster.
Uses: As a reducer (acid solution); test for hypo; hypo eliminator; stain remover and bleacher in redevelopment.

Caution: Powerful oxidizing agent; its stain can be removed with a solution of potassium metabisulfite or sodium bisulfite.

POTASSIUM PERSULFATE
Synonyms: Anthion
Appearance: Colorless or white odorless crystals.
Uses: As a hypo eliminator; bleach bath for reversal development; reducers.

Notes: Keep well closed in a cool place.

Caution: A powerful oxidizing agent.

POTASSIUM SULFIDE
Appearance: Yellow to yellowish red crystals.
Uses: Toning baths.

POTASSIUM THIOCYANATE
Synonyms: Potassium rhodanide, Potassium sulfocyanate, Potassium sulfocyanide, Sulfocyanate, Rhodamide.
Appearance: Colorless, deliquescent crystals.
Uses: Thiocyanate toning baths; silver halide solvent.
Notes: Potassium thiocyanate can produce actual reduction in the size of individual silver halide grains by virtue of its dissolving action. As a result of physical development, it produces a more homogeneous deposition of silver. It is used in concentrations of 1.0 to 1.5 g/liters in certain developers, such as Kodak DK20 (DK-20 is not included in the formulas found in this edition).

Because of its deliquescent nature, thiocyanate should be used in percentage solutions.

PYRO (see Pyrogallol)

PYROCATECHIN
Formulas: 1,2-Dihydroxybenzene; ortho-Dihydroxybenzene.
Synonyms: Catechol, pyrocatechol, catechin, pyrocat.
Appearance: Colorless crystalline needles or scales.
Uses: Developing agent for film or paper; gives warm black images; with caustic soda, gives rapid development with high contrast.

Notes: Pyrocatechin is easily soluble in warm water. It is chemically akin to hydroquinone but with special properties, notably the fact that it oxidizes readily and its oxidation products have a tanning effect upon gelatin.

When used without sulfite, or very low sulfite content, it gives a heavily stained image and tans the gelatin in proportion to the density of the image. This property has led to its use for high-definition and tanning developers (Windisch Extreme Compensating Developer). Used with caustic alkali it is one of the best compensating developers (Maxim Muir's Pyrocatechin Compensating Developer).

All developers containing pyrocatechin should be mixed with distilled water, whether or
not the formula calls for it. Dilute pyrocatechin developers will typically provide a speed increase.

Caution: Poisonous; wear a dust mask and gloves when working with the powder, use adequate ventilation, and wear gloves when using the working solutions. Clean up any powder or spilled solutions, and dispose of the residue safely.

PYROGALLOL
Formulas: 1,2,3 Trihydroxy-benzene; 1,2,3-Benzenetriol.
Trade Names: Piral, Pyro, Pyrogallic acid, Trihydroxybenzene.
Appearance: Fine white powdery crystals (sublimed) or heavy, prismatic crystals; properties of the two forms are the same.
Uses: Active agent in pyro developers.

Notes: At one time, pyro was a universally used developer. It was even available in prepackaged formulas from companies such as Eastman Kodak. Unfortunately, it has been almost entirely replaced by metol-hydroquinone- and Phenidone-hydroquinone-type developers.

The main reasons are that pyro stains, it must be handled carefully, and it does not keep well in solution. In other words, it is not as commercially viable as other forms of developers.

When used correctly, pyro creates a stained image of unprecedented tonal scale, especially in the high values. In combination with either metol or Phenidone, it exhibits superadditive characteristics. It produces an overall stain on the negative, which adds to the contrast of the silver image. The stain is a desirable part of a properly developed pyro image. Pyro tends to oxidize very rapidly in solution and cannot be kept without the aid of preservatives such as sulfuric or other acids, sulfites, etc. Pyro should be added after these preservatives have been mixed with the water. Pyro oxidation products act as strong antifogging agents.

Caution: Pyrogallol is considered to be toxic. Avoid contact with eyes, skin, and clothing.

In case of contact, flush eyes and skin with water. The dry powder should not be inhaled when mixing. Mixing should be performed in a well-ventilated area using gloves, goggles, dust mask, and an apron. Use gloves when using the formula.

SILVER NITRATE
Synonyms: Lapis caustic, Luna caustic, Lunar caustic, Nitrate of silver.
Appearance: Colorless, fl at crystals.
Uses: Most important silver salt used in photography; emulsion making; intensification; etc.

Caution: Stains on fingers can be removed by rubbing with tincture of iodine followed by a strong solution of hypo.

SODA (see Sodium carbonate)

SODIUM ACETATE
Synonyms: Acetate of soda.
Appearance: Colorless, transparent, effl orescent crystals.
Uses: Toning baths; retarder in hydroquinone developer; used to buffer acidity of acid solutions.

Notes: Keep in a tightly sealed bottle in a cool place.

SODIUM ASCORBATE
Synonyms: Soda ascorbate, Sodium Isoascorbate, Vitamin C sodium.
Appearance: White crystals.
Uses: Ecologically friendly developing agent.

Notes: Sodium ascorbate is usually in combination with metol or Phenidone. It may be used as a substitute for ascorbic acid in film developers. It may also be used as a substitute for hydroquinone.

Try using 1.8 times the weight of the hydroquinone. The alkali does not have to be increased because sodium ascorbate is not acidic.

Substitutions: Sodium adsorbate is available in health food stores and the canning goods department of some grocery stores. Ten grams of sodium ascorbate can be substituted with 8.89 grams of ascorbic acid. Sodium ascorbate can be replaced with sodium isoascorbate, weight for weight.

(see Acid, ascorbic; Hydroquinone; and Sodium isoascorbate)

SODIUM BICARBONATE
Synonyms: Acid sodium carbonate, Baking soda, Bicarbonate of soda, Monosodic carbonate, Sodium hydrocarbonate, Sodium hydrogen carbonate.
Appearance: Fine, white powder.
Uses: In hypo baths for fixing self-toning papers; in gold toning baths; in developers to inhibit fog.

SODIUM BISULFATE
Synonyms: Sodium acid sulfate, Sodium hydrogen sulfate.
Appearance: White, crystalline powder.
Uses: Acid rinse and stop baths. In combination with sodium acetate, used as a substitute for acetic acid.

Notes: Sodium bisulfate can be used in conjunction with sodium chloride to make a substitute for hydrochloric acid.

SODIUM BISULFITE
Synonyms: Acid sulfite of soda, Leucogen.
Appearance: White, crystalline powder.
Uses: In acidulating and preserving fi xing baths; as a preservative for pyro developer; for removing silver stains from printing-out paper.

Notes: Can be substituted weight for weight with sodium metabisulfite.

SODIUM BROMIDE
Synonyms: Bromide of soda.
Appearance: White or colorless granules or granular powder.
Uses: As a restrainer in developers.

SODIUM CARBONATE
Synonyms: Carbonate, Carbonate of soda, Sal-soda, Soda, Soda ash, Washing soda.
Appearance: White or colorless, granules or granular powder.
Uses: One of the principal alkali (accelerators) used in development.
Substitutions: Balanced Alkali (Kodalk) can be used as a substitute for carbonate or vice versa.

Sodium carbonate is commonly available in anhydrous and monohydrous forms. The crystalline form is available as Arm & Hammer Washing Soda, which is sodium carbonate decahydrate (use the yellow, unscented box). This can be safely substituted in almost all formulas calling for carbonate.

Notes: Sodium carbonate releases a gas when added to an acid stop bath or an acid fixing bath; this gas may cause pinholes, or “blistering,” to develop in film emulsions.

SODIUM CHLORIDE
Synonyms: Carbonate of soda, Common salt, Kosher salt, Muriate of soda, Rock salt, Salt, Sea salt.
Appearance: Colorless, transparent crystals or white crystalline powder.
Uses: In preparation of chloride emulsions; salting papers before sensitizing and before toning; in hypo alum toning formulas, also acts as a weak restrainer.
Substitutions: Sodium chloride is simply common table salt. However, in the United States, it is almost always mixed with iodine and the iodine is variable in nature and amount. = Therefore, if you wish to buy your sodium chloride from your grocer, use Kosher salt, which is not iodized.

Notes: Can be used in conjunction with sodium bisulfite to make a substitute for hydrochloric acid. (see Acid, hydrochloric)

SODIUM HEXAMETAPHOSPHATE (see Calgon)

SODIUM HYDROXIDE
Synonyms: Caustic alkali, Caustic soda, Hydrate of soda, Hydrated oxide of sodium, Mineral alkali, Soda lye, Sodic hydrate, Sodium hydrate. Trade Names: Red Devil Lye.
Appearance: White, deliquescent lumps or sticks.
Uses: High-energy accelerator or alkali sometimes used to activate low-energy developing agents (e.g., hydroquinone).
Substitutions: Red Devil Lye, available in hardware and grocery stores, can be substituted in almost all formulas for sodium hydroxide.

Notes: Caustic alkali are most often used where a powerful and quick-acting developer is required. Developers compounded with caustic alkali have poor keeping properties and are soon exhausted. Store in a well-sealed bottle. Weigh it rapidly as it can pick up moisture from the air and change its weight.

Caution: Of all the chemicals commonly used in the black and white darkroom, this is perhaps the most caustic. It is the same chemical used in many commercial drain cleaners. Cold water should always be used when dissolving sodium hydroxide because considerable heat is generated. If hot water is used, the solution will boil with explosive violence and may result in serious burns. If the water is not cold enough, the solution may start to steam. If this should occur, add some ice to cool the solution. ***DO NOT BREATHE THE VAPOR. If it starts to steam, leave the room until it is cool***.

It is good practice to dissolve sodium hydroxide separately in a small amount of cold water, then add the solution after the developing agent has been dissolved, stirring vigorously.

Wear a face mask, gloves, and eye protection when working with the powder and solutions.

SODIUM ISOASCORBATE
Synonyms: Iso vitamin C sodium.
Appearance: White crystals.
1Uses: As an ecologically friendly developing agent, usually in combination with metol or Phenidone. It can also be used as a substitute for hydroquinone. Start with 1.8 times the weight of the hydroquinone. Sodium isoascorbate is not acidic so the alkali does not have to be increased.

Substitutions: As with sodium ascorbate, 10.0 grams of sodium isoascorbate can be substituted with 8.89 grams of ascorbic acid. Sodium isoascorbate can be replaced with sodium ascorbate, weight for weight.

Notes: Sodium isoascorbate is made up of the same chemicals as sodium ascorbate, but they are combined in a different pattern. This matters to our bodies, but not to an emulsion! (see Acid, ascorbic, and Sodium ascorbate)

SODIUM METABISULFITE
Synonyms: Sodium pyrosulfite.
Appearance: Colorless crystals or white powder.

Uses: As a preservative in developers; used in place of sodium sulfite in some developers, particularly in two-solution formulas where the increased acidity of the metabisulfite inhibits oxidation. For acidifying fixing baths.

Notes: Can be substituted weight for weight with sodium bisulfite.

SODIUM METABORATE
Trade Names: Kodak Balanced Alkali, Kodalk.
Appearance: White crystals.

Uses: As a mild alkali accelerator in developers of moderate to high alkalinity. Used to avoid the creation of gas when it comes in contact with an acid. For this reason the possibility of blister formation is minimized.
Substitutions: Sodium metaborate, octahydrate (8H2O), and Balanced Alkali (Kodalk) are, for all practical purposes, the same. Substitution can be made weight for weight.

Another substitution for sodium metaborate, octahydrate is to use 9.5 grams of sodium hydroxide and 45.4 grams of borax, decahydrate in water to make 1.0 liter. This is equivalent to a 10% solution of sodium metaborate, octahydrate. This can be made from Red Devil Lye and 20 Mule Team Borax and safely used in formulas as a substitute (20.0 ml of a 10% solution 2.0 grams; 25.0 ml 2.5 grams; etc.). (see Balanced Alkali)

SODIUM PHOSPHATE (DIBASIC)
Synonyms: Disodium orthophosphate, Disodium phosphate, DSP, Secondary sodium phosphate.
Appearance: Colorless, transparent crystals.

Uses: Gold toning; silver chloride emulsions.

SODIUM PHOSPHATE (TRIBASIC)
Synonyms: Normal sodium ortho-phosphate, Tribasic, Trisodium orthophosphate, Trisodium phosphate, TSP, Tribasic sodium phosphate.
Appearance: Colorless, needle crystals; smaller than the dibasic crystals.

Uses: An alkali used as a substitute for caustic and carbonate alkali in negative development. Used as a water softener. Good for cleaning and detoxifying vessels and trays that contained fixer.

SODIUM SULFANTIMONIATE
Synonyms: Sodium thioantimoniate, Schlippe's salt.
Appearance: Large colorless or yellow crystals.
Uses: Toning bromides; negative intensification.

SODIUM SULFATE
Synonyms: Dried sodium sulfate, Glauber's salt, Sulfate of soda, Vitriolated soda.
Appearance: White powder.

Notes: In non-swelling acid rinse baths for roll film and in tropical developers for use at high temperatures. Store in a tightly sealed bottle and store in a cool place.

SODIUM SULFIDE
Synonyms: Sulfide of soda.
Appearance: Colorless, or slightly yellow deliquescent crystals.

Uses: Sulfide toning; silver recovery.
Caution: Should not be kept near light-sensitive materials as it tends to bring about their deterioration. Has the odor of rotten eggs or a high school chemistry experiment. Store in a tightly sealed bottle and store in a cool place. Do not handle with bare hands.

SODIUM SULFITE
Synonyms: Sulfite, Sulfite of soda.
Appearance: White crystals or powder.

Uses: As a preservative of developing agents; constituent of the acid fixing bath; blackener in negative intensification; active energizer in amidol development.

Notes: Sodium sulfite is the most widely used preservative in developers. It also plays an important part in the process itself. By using a sufficient quantity of sulfite, you can prevent the formation of many undesirable by-products during development.

Sulfite is also an important solvent for silver halide. It can therefore have a noticeable effect on the graininess of the silver image at concentrations over 50.0 g/liter.

SODIUM TETRABORATE (see Borax)

SODIUM THIOCYANATE
Synonyms: Potassium rhodanide, Sodium sulfocyanate, Rhodanide.
Appearance: Colorless or white deliquescent crystals.

Uses: Substitute for potassium thiocyanate weight for weight.
Notes: When sodium thiocyanate is dissolved the temperature of the water is considerably lowered. Due to its deliquescent nature, thiocyanate should be used in percentage solutions.

SODIUM THIOSULFATE (HYPO)
Synonyms: Antichlor, Hypo, Hyposulfite of soda, Sodium hyposulfite, Sodium subsulfite.
Appearance: Large, white, transparent crystals and powder.

Uses: In preparation of fi xing baths; ingredient in various reducers.
Notes: Sodium thiosulfate is one of a few known substances that will dissolve silver bromide. As such it is universally used in modern photographic procedures. In this process, which is known as “fixation”, the unexposed silver bromide is dissolved in the sodium thiosulfate by combining with it to form soluble complex thiosulfate of silver and sodium. Hypo is available in two forms: anhydrous and, more commonly, crystalline. Crystalline hypo, when dissolved, lowers the temperature of the water considerably, whereas anhydrous does not.

Always begin with water of at least 90F/32C when mixing the crystalline form. Use 64% of the anhydrous salt as a substitute for crystalline hypo.

STARCH
Uses: For sizing papers and in preparing pastes and adhesives.
Notes: Insoluble in cold water; soluble in hot water, forming a jelly on cooling.

SULFAMIC ACID (see Acid, Sulfamic)

SULFOCYANATE (see Potassium thiocyanate)

SULFURETED POTASH (see Potassa sulfureted)

SULFURIC ACID (see Acid, Sulfuric)

TARTARIC ACID (see Acid, Tartaric)

TEA (see Triethanolamine)

TERTIARY BUTYL ALCOHOL (see Alcohol, Tertiary Butyl)

THIOCARBAMIDE (see Thiourea)

THIOUREA
Synonyms: Sulfocarbamide, Sulphurea, Thiocarbamide.
Appearance: White, prismatic crystals.
Uses: In gold toning baths; clearing yellow stains from prints; in mordant solutions for dye toning.

TRIETHANOLAMINE
Synonyms: TEA.
Appearance: Clear liquid (also available in solid form but not commonly used for photographic applications).
Uses: Developer accelerator and preservative.

TRISODIUM PHOSPHATE (see Sodium Phosphate (Tribasic))”“

(End of Quote from “The Darkroom Cookbook”, By Steve Anchell)

Through the experimentation of different chemical substances, each photographer may find his own way to create their very own work. It is a slow, methodical process, and NOT for just everyone. If you want quick and right now “snap-shots” - chemical and large format photography is not for you. Use a digital camera - or your damn “iPhone”. If you do not like to “fiddle around”, or do not have the pacience for the time involved in creating something unique, do something else. But - If you are one of “*those people*” who truly enjoy the making of anything “different” and wish to make something that few others do these days, chemical photography just might be your “calling”.

Remember - Be Safe - Stay Healthy - and be creative.
Thank you for reading - James R. Kyle, Photographer - Saint Louis, Missouri, U.S. of A.